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ONE-STEP PHOTOGRAPHY

The purpose of this investigation is essentially aesthetic, although the realm of investigation is, of course, scientific and technical. The aesthetic purpose is to make available a new medium of expression to the numerous individuals who have an artistic interest in the world around them, but who are not given to drawing, sculpture, or painting. For most people photography cannot compete with these arts, partly because of the intricacies of photographic manipulations and partly because of an important fundamental difference in the approach to the creative problem. In the earlier arts the artist initiates his activity by observing his subject matter and then responds, as he proceeds, to a two-fold stimulus: the original subject matter and his own growing but uncompleted work. With photography, except for those who combine long training, high technical ability, and splendid imagination, this important kind of double stimulus — original subject and partly finished work — cannot exist. Consequently, for most people it has been of limited and sporadic interest and has not been a source of deep artistic satisfaction, and there has arisen the gulf between the majority who make snapshots as a record and as a gamble, and the minority who can reveal beauty in this medium. We cannot establish what may be a fact, that artistic ability and need for artistic expression is almost universal, although talent and facility for such expression is obviously not universal. It does seem certain, however, that an enormous number of people who lack talent or inclination for the early arts, *do* have the taste for and the need for a simplified medium of artistic expression.

This new photographic program seeks to contribute to satisfying this aesthetic need. By making it possible for the photographer to observe his work and his subject matter simultaneously, and by removing most of the manipulative barriers between the photographer and the photograph, it is hoped that many of the satisfactions of working in the early arts can be brought to a new group of photographers. The process must be non-existent for the photographer, who by definition need think of the art in the *taking* and not in *making* photographs.

Edwin H. Land, May 31, 1949

From a paper delivered to the Royal Photographic Society of Great Britain

March 23, 1972

Dear Shareholder:

When we made our plan to revolutionize our own revolution by a complete restatement of our still camera and film, we sought a context that would keep the company prosperous during the transition from our present system to the new one. The essence of our plan for the transition was to design a superb low cost camera of the present type, similar to Colorpack II, characterized by ease of use and great reliability, with an excellent lens, a meticulously accurate integrating shutter, and an economical format of our present color film. We enter 1972 with this kind of camera and film, and with the satisfaction that comes from knowing that the power of our experience and position has been directed to make available to everybody, at minimum cost, the best combination of camera and film possible within the conceptual framework of the last ten years. There is already every indication that this combination, Square Shooter 2 and Type 88 color film, will be successful. Assured by roughly one billion pictures made with all of our cameras last year, and by last quarter sales that were the best in our history, we

feel that this addition of a smaller format, low cost camera, to the group of other cameras of the present type will provide a firm base for operations while we grow into the dramatic next stage of our kind of photography.

The word "programmed" has crept from computer language into behavioral psychology. Perhaps Polaroid's activity in photography has been "programmed" by the statements on the cover of this report. Despite the maturing of twenty-five years, despite changes of departmental managers, despite the evolution of the photographic market itself, Polaroid can be seen to have pursued a single direction: a camera and film system designed to be with most of us most of the time, a system that will be a partner in perception, enabling us to see the objects in the world around us more vividly than we can see them without it, a system to be an aid to memory and a tool for exploration.

Some years ago it began to dawn on us that in spite of our best intentions, our kind of photography tended to be thought of as a quick kind of ordinary photography. We realized that we had not

fully achieved our goal of creating a new medium in itself. We have felt the implications of this medium are as different from other photography as the implications of television from radio. It is not a question of developing apparatus to serve an old medium, but rather of appreciating the full human significance of the new medium and then providing appropriate materials and apparatus for it.

As proud as we are of the camera-film systems we have designed in the past, it is clear to us that a whole new set of specifications is required for our photography to leave the past behind and to become a new medium in itself. A camera must be easy to carry in pocket or pocketbook; it must go directly to open position and back to closed. A camera must be first of all a viewing and composing device, for the picture must exist in the eye of the photographer before it emerges from the camera. There must be nothing for the photographer to do except to compose and to select the instant at which he wants to go from viewing to having. When he is happy with what he sees, the picture must appear magically

outside the camera. In short, "The process must be non-existent for the photographer, who by definition need think of the art in the taking and not in making photographs."

The very definition of a new medium is that it alters the relationship of people to the world around them. It is only after that alteration has occurred that people can sense the change. Obvious examples of this phenomenon are the effects of the telephone or television on our culture as a whole. And so, in a much smaller but yet significant way, we find that our kind of photography can change the interaction of people with the world around them. The possibility for this new interaction with the world has been implied by our systems up until now. What pleases us is the discovery that when we now include in a camera-film system all of the things which in the past seemed to us desirable, a system emerges in which the whole is greater than the sum of the parts. In using it we have experienced a new medium as a full-blown reality.

The pictures themselves are frequently astonishing, having qualities for which we have no names, and which we've never seen before in photographs. It is as if the observer sees the object rather than the picture of it; furthermore, the pictured object stands out with clarity beyond that apparent in the object itself. We know, of course, with what qualities we had hoped to endow our photographs, but we were not prepared to find that when we had done nearly everything we hoped to do, our field would cross the threshold to becoming a new medium.

In my letter of March 18, 1971, I said, "The picture I have given of corporate activity makes clear that one cannot cover the question of how far along a product is in its development by saying it is out of research or into pilot or into manufacturing-development or anywhere in the old-fashioned sequence. A significant new product in contemporary corporate life emerges on all these fronts at once and then quite suddenly is complete." It is this kind of emergence that we are now experiencing: new film pack, new film

system, new negative, new reagents, new shutter, new electronics, new power system, new lens, and so on and on.

We are manufacturing sizable quantities of most of the components of the film, including our new negative, with which we are very pleased. Although the cameras we are making on the pilot line predispose us towards optimism, we do not plan to set our final schedule until we have accumulated experience on the actual production line.

The long trip which started in 1944 towards an absolute one-step photographic process seems to be coming to a very happy conclusion: the revolutionary technological steps have been completed and the great hypothetical advances are now all embodied in operating cameras and film which are, to us, breathtaking delights.

Edwin Land

		1971	1970*
Financial Highlights	Net sales and other income	\$541,369	\$507,735
	Earnings before taxes	116,692	127,024
Data in thousands, except earnings per share, percent and shareholder figures	Net earnings	✓ 61,018	✓ 65,974
	Earnings per share	✓ \$1.86	✓ \$2.01
	Net earnings as percent of sales and other income	11.3%	13.0%
	Net earnings as percent of shareholders' equity	11.2%	13.4%
	Additions to property, plant and equipment	\$ 60,167	\$ 67,910
	Shareholders' equity, end of year	544,180	493,050
	Shareholders of record, end of year	45,252	47,830

*Restated on worldwide consolidated basis.

1971 Worldwide Results

For the first time Polaroid's financial results for the year are being presented on a worldwide consolidated basis. Details of this change are to be found in the footnote entitled "Principles of Consolidation" on page 12.

Polaroid's worldwide sales reached record levels in 1971. Consolidated sales and other income totalled \$541,369,000, an increase of 6.6% from \$507,735,000 (restated on a consolidated basis) in 1970. The fourth quarter was the largest quarter in the Company's history. Strong demand for cameras and film during the Christmas selling season resulted in sales and other income of \$179,056,000, 14.8% above the fourth quarter of 1970.

Net earnings of the Company on a consolidated worldwide basis were \$61,018,000 compared with \$65,974,000 (restated on a consolidated basis) in the previous year, a decline of 7.5%. Per-share earnings were \$1.86 based on the average number of shares outstanding in 1971 (32,837,123) compared with \$2.01 (restated) based on the average number of shares outstanding in 1970 (32,831,133).

The decline in earnings reflected continued extraordinary expenditures for research, engineering, manufacturing development and other costs related to Polaroid's next generation of instant photographic systems. New factories in the Boston area to supply elements of our new camera system have been completed and are in various stages of preproduction testing. These include a color negative plant in New Bedford; a film assembly plant and a chemical supply plant in Waltham; and a camera manufacturing plant in Norwood. In addition, a transparency film plant currently in the pilot phase has also been built in Norwood.

Year-end working capital was \$330,908,000, an increase of \$13,714,000 from the 1970 figure. During the year, dividend payments amounted to \$10,508,000 and capital expenditures for production facilities and other property totalled \$60,167,000. (A summary of financial highlights appears on Page 7.)

Domestic Results

Sales and other income of the parent company and its domestic subsidiaries increased by 5.7%. The fourth quarter of 1971 established a record for domestic sales and other income.

It was a peak year for pack film sales, which produced more revenue in 1971 than the total worldwide Company sales in 1965. Camera sales were also strong, especially in the second half of the year. Unit sales of the more expensive folding pack cameras were ahead of the previous year by 12%. Sales of industrial products continued strong in 1971.

International Results

Polaroid's international operations showed continued growth in 1971. Marketing subsidiaries have recently been established in Puerto Rico and Denmark. Two international distribution subsidiaries have also been set up, one in Panama and one in Hong Kong. Polaroid now has marketing subsidiaries in 15 countries, distribution subsidiaries in three countries and manufacturing facilities in Scotland and The Netherlands. Total sales and other income of foreign subsidiaries increased by 30% in 1971. Record sales levels were achieved for amateur cameras, film, industrial products and sunglasses.

New Products

This Spring Polaroid introduced a new, inexpensive color camera called Square Shooter 2. Priced at less than \$25, it is the most versatile

color camera Polaroid has ever offered in this low price range. It features a three-element lens, integrating electronic shutter and electric eye exposure control, and uses flashcubes. It is designed to use the new square format color film, Type 88, introduced in 1971. Pictures made with Type 88 and the Square Shooter 2 cost about 25 per cent less than the larger Type 108 color pictures and about the same as conventional color pictures processed by the manufacturer. An international version of this camera, called Colorpack 80, was introduced to foreign markets several months earlier.

Patents

In 1971, 168 new U.S. patents were issued to the Company, 157 of them in the field of one-step photography. At the end of the year we held 1,238 outstanding U.S. patents, 1,088 of which related to one-step photography. Our foreign patent coverage was also extended considerably during the year.

Community Relations

During 1971, the Company continued its participation in community affairs with particular emphasis in Cambridge and Boston and increasing activity in New Bedford. The Company has provided loans of personnel, financial grants and assistance of other kinds for a variety of programs including day care and prison reform. Because of the depressed state of the local economy during the past year Company efforts were also directed toward the development in the community of training and skills-development programs. The Company has received many citations and awards for its efforts in connection with urban problems. Among those received this year was a citation from the President's Committee on The Employment of the Handicapped.

South Africa

For the past year Polaroid has been conducting an experimental program with its distributor in South Africa to improve the salaries and other benefits of their black employees. In addition the Company has made grants to two black educational organizations and has set up an educational foundation to provide aid to black students and teachers in South Africa. These funds have been generated from sales of Polaroid products there.

Wages of the distributor's black employees have increased an average of 22% during the year and it is believed that further progress is possible. The educational grants have produced results both positive and hopeful for the future. No opposition to any of these activities was encountered from the South African government. In view of the progress that has been made, the Company has decided to continue the program.

Pollution Control

In 1971 Polaroid expanded and improved programs for the reduction, salvage and recycling of solid waste generated by our manufacturing operations. These programs, which include salvage of steel, materials-handling pallets, plastic, and corrugated paper, have substantially reduced the amount of waste from the various facilities.

Polaroid continued its intensive consumer education effort against littering with anti-litter messages on all components of its film products and packages as well as on television. The protective foil bag in which pack film is sealed was redesigned to be used as a litter bag by the picture taker.

The Company is using recycled paper in the production of instruction materials, intracom-

pany communications, reports to shareholders (including this report) and office supplies. The bi-weekly *Newsletter* for Polaroid employees is now printed on paper made from trimmings from the printing of product instructions.

A second thermal oxidizer has been put into operation in Waltham to burn solvents and other chemical wastes at extremely high temperatures with no harmful emissions.

A massive liquid treatment plant in New Bedford will be in operation this spring at Polaroid's new negative manufacturing plant there. This more than \$2,000,000 facility is designed to recover valuable chemicals in addition to treating liquid wastes.

Human Relations

During a period of increased national unemployment Polaroid had no layoffs in 1971. On the contrary, the Company population increased in 1971 by about 10% as hiring proceeded for the new production facilities. Many employees moved to new jobs as internal priorities shifted to the new projects. Over 60% of all job openings were filled by candidates inside the Company.

During 1971 a major revision was made in the hourly wage plan of the Company. Polaroid has developed a job "family" concept which provides more clearly defined opportunities for employee growth.

Polaroid continues to emphasize employee education with Company classes and programs, as well as a tuition payment plan for members who are continuing their education at other institutions.

The Company has undertaken an ambitious goal in minority hiring and is making steady

progress in hiring and promoting more black employees to higher level jobs.

A major new medical clinic for Polaroid employees was opened in Cambridge which, in conjunction with centers in other locations, handled 55,000 office visits, including over 1,000 comprehensive physical examinations.

Organizational Changes

David W. Skinner, formerly Vice President and Vice Chairman of the Board of Directors, retired from the Company after 27 years of service. He will continue as a member of the Board. Senior Vice President and General Manager Arthur Barnes retired from the Company after 30 years of service. He was elected to the Board of Directors. Vice President Mark Sewall retired from the Company after 20 years. Peter Wensberg and Thomas H. Wyman were named Senior Vice Presidents. Mr. Wyman was also made General Manager. Treasurer Harvey H. Thayer was made Vice President and Treasurer. Christopher C. Ingraham and Murray Swindell became Assistant Vice Presidents.

The First National Bank of Boston was appointed as a Co-transfer Agent and Co-registrar.

**Consolidated Statement
of Financial Condition**
December 31, 1971 and 1970
(Thousands of dollars)

NET ASSETS	1971	1970*
Current assets		
Cash	\$ 15,620	\$ 14,403
Marketable securities, at cost (Note 2)	178,562	196,389
Receivables, less allowance of \$1,100 (\$1,035 in 1970)	115,476	107,852
Inventories (Note 3)	85,021	55,778
Prepaid expenses and other current assets	9,176	6,089
Total current assets	403,855	380,511
Current liabilities		
Payables and accruals	45,127	38,722
Domestic and foreign income taxes (Note 4)	27,820	24,595
Total current liabilities	72,947	63,317
Working capital	330,908	317,194
Property, plant and equipment, at cost (Note 5)		
Land	2,949	2,727
Buildings	98,814	71,848
Machinery and equipment	157,940	120,990
Construction in progress	56,956	63,314
	316,659	258,879
Less accumulated depreciation	103,387	83,023
Net property, plant and equipment	213,272	175,856
Patents and trademarks (at nominal value of \$1)	—	—
Total net assets	\$544,180	\$493,050

OWNERSHIP OF NET ASSETS

Capital and retained earnings (Note 6)

Common stock, \$1 par value, authorized 36,000,000 shares, issued: 1971 32,840,200 shares (1970 32,831,950 shares)	\$ 32,840	\$ 32,832
Additional paid-in capital	120,455	119,843
Retained earnings	390,885	340,375
Total ownership of net assets	\$544,180	\$493,050

See accompanying notes to consolidated financial statements.

*Restated on worldwide consolidated basis.

**Consolidated Statement of Earnings
and Retained Earnings**Years ended December 31, 1971 and 1970
(Thousands of dollars)

	1971	1970*
Net sales	\$525,507	\$492,095
Other income, including interest and royalties	15,862	15,640
Total net sales and other income	541,369	507,735
Cost of sales	243,397	240,260
Selling, research, engineering, distribution and administrative expenses	181,280	140,451
Total costs	424,677	380,711
Earnings before taxes	116,692	127,024
Domestic and foreign income taxes (Note 4)	55,674	61,050
Net earnings (per share: 1971 \$1.86; 1970 \$2.01)	61,018	65,974
Retained earnings at beginning of year	340,375	284,907
	401,393	350,881
Deduct cash dividends paid (\$.32 per share)	10,508	10,506
Retained earnings at end of year	\$390,885	\$340,375

**Consolidated Statement of Changes
in Financial Position**Years ended December 31, 1971 and 1970
(Thousands of dollars)

Source of funds	1971	1970*
Net earnings	\$61,018	\$65,974
Depreciation and obsolescence	22,751	20,479
Funds derived from operations	83,769	86,453
Proceeds from exercise of stock options	620	122
Total	84,389	86,575
Use of funds		
Additions to property, plant and equipment	60,167	67,910
Cash dividends	10,508	10,506
Total	70,675	78,416
Net increase in working capital	\$13,714	\$ 8,159

Summary of changes in working capital

Increase (decrease)

Current assets

Cash and marketable securities	\$(16,610)	\$(1,896)
Receivables	7,624	(2,579)
Inventories	29,243	(3,912)
Prepaid expenses and other current assets	3,087	1,566
Total	23,344	(6,821)
Current liabilities	(9,630)	14,980
Net increase in working capital	\$13,714	\$ 8,159

See accompanying notes to consolidated financial statements.

*Restated on worldwide consolidated basis.

Notes to Consolidated Financial Statements

December 31, 1971

1. Principles of Consolidation

In 1971 the Company changed its consolidation policy to include all wholly-owned subsidiaries in its financial statements. Prior to 1971, subsidiaries operating outside the United States were excluded from consolidation and their earnings were recognized only when received as dividends by the Company. This policy was changed to reflect the worldwide nature of the Company's business and the increasing significance of operations outside the United States.

For comparative purposes, the 1970 financial statements have been restated. As a result, after elimination of all intercompany items and transactions, amounts previously reported for net sales and other income have been increased from \$444,285,000 to \$507,735,000, net earnings from \$61,136,000 to \$65,974,000 and earnings per share from \$1.86 to \$2.01. On a comparable basis for 1971, net sales and other income increased from \$469,584,000 to \$541,369,000, net earnings from \$56,978,000 to \$61,018,000 and earnings per share from \$1.74 to \$1.86.

At December 31, the net assets of subsidiaries operating outside the United States were \$26,080,000 in 1971 and \$20,293,000 in 1970. For the years ending December 31, 1971 and 1970, net sales and other income of these subsidiaries were \$115,805,000 and \$88,788,000 respectively.

Earnings statements of consolidated subsidiaries operating outside the United States have been translated from local currencies into U.S. dollars at average monthly exchange rates for the year. Current assets and current liabilities of these non-U.S. subsidiaries have been converted to U.S. currency at the exchange rates which were in effect at year end. Property, plant and equipment and ownership equities have been converted at historical rates. Included in the consolidated net earnings for

1971 is a gain of \$2,385,000 resulting from translation of non-U.S. currencies into U.S. currency.

2. Marketable Securities

At December 31, 1971, the book value of marketable securities maturing in 1972 was \$139,486,000, the remainder maturing in 1973-1975. Discount or premium from par value is amortized over the term of the obligation. Market value at December 31, 1971, was \$181,040,000.

3. Inventories

Inventories are valued at the lower of cost (first-in, first-out) or market value. Classification for the respective years was:

	1971	1970
Raw materials	\$37,887,000	\$28,345,000
Work in process	9,279,000	6,930,000
Finished goods	37,855,000	20,503,000
Total	\$85,021,000	\$55,778,000

4. Income Taxes

During 1971 the Company and the Appellate Division of the Internal Revenue Service reached agreement on the remaining issues from the examination of the years 1965-1967. The additional tax paid, which was not material, had been provided in the accounts of prior years.

The Company reflects investment tax credit as a reduction of income taxes in the year in which the credit occurred.

5. Property, Plant and Equipment – Depreciation Policy

The cost of buildings, machinery and equipment is depreciated over the estimated useful lives of such assets primarily by accelerated depreciation methods. Depreciation expense amounted to \$22,329,000 in 1971 and \$17,477,000 in 1970.

6. Stock Options

Under the Company's stock option plan, "qualified options" may be granted to purchase shares of common stock at fair market

value on the date of grant. Options are exercisable not less than one year after the date of grant and expire five years after the date of grant.

Changes in the number of shares under options outstanding but not yet exercised are summarized below:

	Number of Shares	Option Price Range Per Share
Balance January 1, 1971	45,650	\$73.25-\$130.00
Options granted in 1971	54,400	103.13
Deduct:		
Options exercised	8,250	73.25- 93.00
Options cancelled	11,500	73.25-130.00
	34,650	
Balance December 31, 1971	80,300	\$92.25-\$130.00
Exercisable at December 31, 1971	20,050	\$92.25-\$130.00

A balance of 217,600 shares was reserved for issuance at December 31, 1971 of which 137,300 shares were available for future grants. The increases in "Common stock" and "Additional paid-in capital" were attributable to the proceeds realized upon exercise of stock options during the year.

7. Contingency

In 1970 the Department of Justice commenced an anti-trust investigation involving the relations between the Company and Eastman Kodak Company. All information requested by the Department has been furnished. In the opinion of management and the Company's general counsel, the Company has conducted its activities with Eastman Kodak Company in conformity with the requirements of the law.

Independent Auditors' Report

The Board of Directors and Shareholders
Polaroid Corporation:

We have examined the consolidated statement of financial condition of Polaroid Corporation and subsidiary companies as of December 31, 1971 and the related statement of earnings and retained earnings and the statement of changes in financial position for the year then ended. Our examination was made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances. We did not examine the financial statements of certain of the foreign subsidiaries, which statements reflected assets and revenues constituting 11% and 21%, respectively, of the related consolidated totals. These financial statements were examined by other auditors whose reports thereon have been furnished to us and our opinion expressed herein, insofar as it relates to the amounts included for these subsidiaries, is based solely upon the reports of the other auditors.

In our opinion, based upon our examination and the reports of other auditors, the above mentioned financial statements present fairly the financial position of Polaroid Corporation and subsidiary companies at December 31, 1971 and the results of their operations and changes in financial position for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year, after giving retroactive effect to the change in the principles of consolidation as described in note 1.

Peat, Marwick Mitchell & Co.

PEAT, MARWICK, MITCHELL & CO.
One Boston Place
Boston, Massachusetts
February 14, 1972

Ten Year Financial Review[†]
Data in thousands, except earnings
per share and employee figures.

	1971	1970
Operating results		
Net sales and other income	\$541,369	\$507,735
Earnings before taxes	116,692	127,024
Income taxes	55,674	61,050
Net earnings	61,018	65,974
Earnings per share	1.86	2.01
Financial position, end of year		
Working capital	\$330,908	\$317,194
Net property, plant and equipment	213,272	175,856
Shareholders' equity	544,180	493,050
Other statistics		
Additions to property, plant and equipment	\$ 60,167	\$ 67,910
Depreciation	22,329	17,477
Number of employees, end of year	11,654	10,528
Payroll and benefits	\$136,741	\$118,346
Shares outstanding, end of year*	32,840	32,832

[†]All years prior to 1971 restated on a worldwide consolidated basis.

*All prior years adjusted for 4-for-1 split effective December 30, 1964, and 2-for-1 split effective February 21, 1968.

1969	1968	1967	1966	1965	1964	1963	1962
\$522,197	\$443,895	\$409,753	\$355,544	\$216,823	\$146,888	\$129,088	\$107,130
145,626	135,053	116,643	95,011	58,188	36,873	24,934	22,174
74,445	72,899	58,303	48,158	28,865	18,139	13,435	11,956
71,181	62,154	58,340	46,853	29,323	18,734	11,499	10,218
2.19	1.96	1.84	1.48	.93	.59	.37	.33
\$309,035	\$176,094	\$138,246	\$104,220	\$ 87,180	\$ 68,275	\$ 52,628	\$ 47,985
128,426	99,856	86,669	68,514	39,143	31,471	28,156	22,807
437,913	276,961	223,769	171,656	127,135	98,792	80,757	71,038
\$ 45,059	\$ 26,263	\$ 29,812	\$ 37,507	\$ 15,741	\$ 7,753	\$ 9,955	\$ 7,991
16,051	13,271	10,705	7,538	5,870	5,317	4,433	3,446
10,506	8,844	8,165	7,925	5,584	3,868	4,082	3,653
\$113,561	\$ 90,367	\$ 78,425	\$ 62,293	\$ 43,658	\$ 32,824	\$ 30,205	\$ 25,754
32,828	31,712	31,660	31,614	31,548	31,502	31,478	31,430

Board of Directors

Edwin H. Land, Chairman of the Board, President, Director of Research
Arthur Barnes, former Senior Vice President and General Manager; President of the
Norumbega Foundation.
Carlton P. Fuller, retired; former Vice President and Treasurer.
Richard D. Hill, Chairman of the Board of First National Boston Corporation.
Carl Kaysen, Director, Institute for Advanced Study, Princeton, New Jersey.
James R. Killian, Jr., Honorary Chairman of the Corporation of Massachusetts Institute
of Technology.
Henry Necarsulmer, General Partner, Kuhn, Loeb & Co.
Julius Silver, Vice President; Partner, Silver, Saperstein, Barnett & Solomon, Attorneys.
David W. Skinner, retired; former Vice Chairman of the Board and Vice President.
L.Z. Morris Strauss, Director of The Flumen Corporation.

Officers

Edwin H. Land, Chairman of the Board, President, Director of Research.
Julius Silver, Vice President, Chairman Executive Committee.
William J. McCune, Jr., Executive Vice President.
Thomas H. Wyman, Senior Vice President and General Manager.
Peter Wensberg, Senior Vice President.
Richard W. Young, Senior Vice President.
Charles Mikulka, Vice President.
Howard G. Rogers, Vice President and Senior Research Fellow.
Louis D. Scott, Vice President.
Paul E. Sullivan, Vice President.
Harvey H. Thayer, Vice President and Treasurer.
Otto E. Wolff, Vice President.
Sheldon Buckler, Assistant Vice President.
Robert C. Duncan, Assistant Vice President.
Christopher C. Ingraham, Assistant Vice President.
Murray Swindell, Assistant Vice President.
Herbert S. Kassman, Secretary.

Management Executive Committee

Thomas H. Wyman, Chairman, Edwin H. Land, William J. McCune, Jr., Charles Mikulka,
Julius Silver, Peter Wensberg, and Richard W. Young.

General Counsel

Silver, Saperstein, Barnett & Solomon
60 East 42nd St., New York, New York 10017

Auditors

Peat, Marwick, Mitchell & Co.
One Boston Place, Boston, Massachusetts 02108

Transfer Agent

Morgan Guaranty Trust Company of New York
30 West Broadway, New York, New York 10015
(Inquiries about stock certificates should be addressed to Morgan Guaranty)

Registrar

Chemical Bank
20 Pine Street, New York, New York 10015

Co-Transfer Agent and Co-Registrar

First National Bank of Boston
P.O. Box 644
Boston, Massachusetts 02102

Executive Office

Polaroid Corporation, Cambridge, Massachusetts 02139

Shareholders' Meeting

April 25, 1972, 2:00 p.m.,
Kendrick Street, Needham, Massachusetts

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file - Polaroid Corp Canada Ltd

May 21 1963

AR27

Now "one-minute" color for 1963 photographers

BY EDWARD HIGHE

WE WERE AT luncheon. My neighbor took a camera out of the case that he had left on the floor beside him. He made his way to the end of our table, backed a bit looking into the camera viewer, then there was a flash of light and he resumed his seat. He placed the camera on the table and, after consulting his watch, pulled out a black tab protruding from the side of it.

A minute passed. My neighbor opened up the back of the camera, and removed the print it contained. "How's that?" he asked.

It was a color picture of the luncheon party, perfect in every detail as far as I could judge. My reaction was neither bright nor original.

"What next?" I said with an incredulous headshake.

It was my introduction to "one step" color photography and it left me staggered—hence the question. Upon reflection, however, I saw that the question I had used to express incredulity, is one that when answered becomes a key to invention itself. What next?—that is the stimulator of inventive genius. Question and answer may be prompted by something inconsequential—a chance word perhaps, a piece of faulty equipment, something seen.

**New process produces results which
surpass conventional color prints**

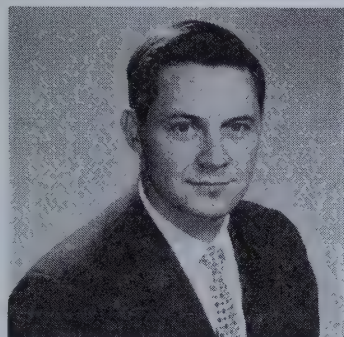


Above: "One-minute" color pictures taken by amateurs.

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In the case of "one step" photography—black and white at first—the spark was provided for the inventor, Dr. Edwin H. Land, by his daughter when he was taking pictures of her in the early forties. She was impatient to see the pictures and he explained that it would take time to get them developed. In telling her this he real-



In Canada: Nickolas Bay.

THE POLAROID CORPORATION of Canada Ltd., was established in 1959 with the idea of manufacturing in this country as soon as sales volume warranted it. Sales have been good and eventually there is little doubt that the company will manufacture here, but because of unforeseen factors this development has been delayed.

The General Manager of the Polaroid Corporation of Canada Ltd., is Nickolas Bay, a typical Polaroid man—young, keen and with a tremendous admiration for Edwin Land.

"The truly big thing about Dr. Land is not his inventive genius," he told me, "but his recognition of our social needs now that we have attained an age of plenty. He sees the urgency of making a man's work-life as dignified and interesting as his family-life is if we are to avoid mass boredom and mental stultification. He regards this as the next phase in the industrial revolution . . ."

It came almost as a shock to me to discover that Nick Bay had only been with the company since 1956, for he talked with such pride and enthusiasm that I judged he must have been with the founder from the beginning. From the turning-point year at any rate—which was 1947.

Being placed in charge of the Canadian operation was a move up for Nickolas Bay, but to him it is not so much a promotion as an opportunity. He is enthusiastic about Canada and is counting on building up a near-autonomous Canadian organization handling the company's sales in this country—and later on its manufacturing activities. E.H.

ized that here was something basically wrong with photography—that to be fully satisfying the picture ought to be available at once with processing carried out automatically within the camera.

FOR 'DIN' LAND, inventor, physicist and businessman, here was the answer to the question of: "What next?"

There were plenty of experts to tell him that what he proposed was impossible, but he confounded them all and by 1948 the Polaroid Corporation, which he had formed for an entirely different purpose, successfully launched picture-in-a-minute photography.

In 1960, with the development of new picture rolls, the time lapse was reduced to 10 seconds and this year has come the most important development to date—"one step" color photography.

The Polaroid Corporation was founded in 1937 to manufacture and market another of Edwin Land's inventions—the world's first polarizing sheet material. Land's interest in polarization was aroused on a visit to New York in 1926 when he was still a freshman at Harvard. He was walking along Broadway at night watching the traffic when it occurred to him that if a polarized, transparent sheet could be developed it might be used for automobile windshields and lights and would eliminate headlight glare.

He was only seventeen at the time, but the idea impressed him so forcibly that he took leave of absence from college to work full-time developing a polarized sheet material in a small laboratory he set up in New York. By 1928 he had perfected his invention and had no difficulty in obtaining a basic patent for it, but this proved of no immediate help, for the automobile manufacturers proved reluctant to equip their cars with polarized windshields and headlights.

The company, established in 1937 with headquarters in Boston, developed other products, however, and by 1941 when the U.S. entered the war, it had built up its sales of sunglasses and filters to the million-dollar mark for the year. During the war the company turned out military optics and in 1945 Polaroid's sales reached nearly \$17 million.

But after the lush war years there came a period of painful re-adjustment for the Polaroid Corporation, and in 1947, instead of a handsome profit, it chalked up an operating loss of \$2 million. Fortunately Edwin Land, whenever he could find time, had been working on the idea of "one step" photography and by 1947 his plans were virtually complete.

The company had no money available for manufacturing so a contract for 10,000 cameras was given to a small Rochester firm which took on the job as a gamble. The camera went on sale in November 1948 and it soon became apparent that it was going to catch on—that Land had correctly estimated what the reaction would be to automated photography.

In 1949 the company's sales had climbed to nearly \$7 million, of which over \$5 million came from the new camera and film. In 1961, twenty-two years later, sales exceeded one hundred million dollars.

Based on the present price of its shares which were recently quoted at \$142 in New York the value placed upon the company is well over half a billion.

Land had relatively little difficulty in getting backing for the Polaroid Corporation when the company was formed in 1937, but the financiers who supported him with an initial investment of \$375,000 did so in the expectation that his first dream would come true. They had strong hopes that Detroit would put Polaroid filters on all its new cars.

In this they were disappointed, but their faith in Land did not waver and they put up a further \$375,000 in 1939 completing their commitment for \$750,000. Since then there have been two stock issues—one for \$2,100,000 in 1945 to provide for post-war reconversion and another for \$12,000,000 in 1958 to provide for development.

PERHAPS ONLY a physicist can appreciate the magnitude of Land's achievement in reducing black-and-white photography to a single process carried out within the camera and involving nothing more than the pulling out of a tab by the photographer. Land had to devise a way not merely to develop the negative, but to make a print on a facing sheet of paper which would be dry and permanent when removed from the back of the camera. He did it in hours pried loose from an unbelievably full schedule of regular work—did a job in a matter of months that would have taken a team of scientists years to accomplish.

There is no doubt that Edwin Land's genius is nurtured by his power to concentrate on a problem for hours on end. After a stretch of heavy concentration, he explains, his mind becomes increasingly adept at suggesting answers to problems; it is as if a mental overdrive comes into play.

The value of this augmented capacity in the working out of problems is obvious, but even more valuable is the other aspect of inventive genius—



Dr. Edwin H. Land, physicist, inventor and businessman.

the magic, intuitive flash which leads to the posing of the problem. How this occurred in the first place we have already seen; it was prompted by his daughter's impatience. "One step" color photography was not so much a flash as a follow-up—a development of the original idea.

But it was a staggering follow-up—comparable to jumping at once from a first orbit to a manned flight to the moon. It involved problems of almost inconceivable complexity.

The essential feature in black-and-white "one step" photography is the use of a pod which ruptures when the tab attached to the film is withdrawn. The pod contains a reagent to develop the negative and a chemical compound which has the ability to pick out the unexposed silver grains in the negative, in their inert and invisible state, and transfer them to the paper where they are converted into metallic and visible silver forming an exact counterpart of the negative image.

THE PROCESS CAN be stated simply—but devising a chemical compound which could transfer the silver grains unscathed to the print in the presence of an active reagent appeared insoluble. But Dr. Land solved it. And having solved it, he was ready for the next move—into color photography.

It is impossible to bring out the highlights of the color story with-

out giving a sketch of Land himself, and an account of his unusual qualities. When one gets to know him and sees what he is trying to do, his inventions—marvellous as they are—diminish in importance in the light of the greater purpose that animates him. This greater purpose is to promote a new kind of industry for people who vary in abilities so that each man's job is interesting and satisfying according to the individual's competence and needs.

He expressed what he had in mind in a Commencement Address at the Massachusetts Institute of Technology recently. He said in part:

"For some time it has seemed to me that the second great product of industry should be the deeply rewarding working life for every man. It has seemed to me that the next stage in raising our standard of living involves not the increase of material holdings, or the amount of food and clothing, but the conversion of the everyday working life into one which develops all the talents of the worker, making him into artist, artisan, student and producer. It has seemed to me the time has come in industry for a planned relationship between machines and people in which the machines would work for people, instead of having people work for machines in the unplanned and accidental relationship that exists today."

To develop this new kind of in-

dustry, Land says, will take tremendously intricate planning, not at Government level for he recognizes the danger of this, but planning on a voluntary basis by the industries themselves. This is an engineering task, he contends, to be undertaken as a new aspect of the engineering life.

He visualizes the industrial complex of tomorrow as made up of thousands of small planned societies, each being a cultural variant of the others, each being its own kind of experiment in such questions as: What is worth making? How should it be made? How should people gather together to make it? How do we relate people to each other in each of these separate little gatherings?

He does not expect the new kind of engineer he envisages to come up with a uniform design for industry generally, but to plan for the individual industry, taking into account such factors as social organization, creative incentive, production and so on, just as an architect takes into account the controlling physical factors in a new building he is designing.

It sounds a formidable plan, but Land is setting the pattern for it in the case of the Polaroid Corporation. He sees the chief defect of our present system as being the denial of interesting and satisfying jobs to the bulk of the labor force—denial to them as well of creative opportunity. In order to alleviate this condition in the case of his own company he has started what is called the Pathfinder Program.

Under the program employees who feel that the job in which they are engaged is not in line with their particular capabilities are encouraged to look around within the corporation for the type of work which they believe would give them greater satisfaction. When a job becomes available in the company it is advertised for two weeks on the company bulletin board and any employee can apply for it if he feels that it is the type of work he would enjoy.

A young fellow in the shipping department may feel that given an opportunity he would do well as a laboratory technician—it's the sort of work that appeals to him. He sees on the bulletin board a position vacant, for laboratory assistant, so he applies for it and is taken on, working half the time in the laboratory learning the new job, and half his time at the old job in the shipping department. If he shows an aptitude for laboratory work and if he finds it to his liking, the transfer is made permanent. If the embryo technician wants to pursue his studies in his own time, the company will pay the cost of the course he elects to take.

It is clear from what he is doing that Dr. Land conceives an industry as a team operation with all members of the team contributing according to their capacity for the production of something worthwhile. Holding such ideas it is natural that he should have drawn into the company men with the pioneer urge to push beyond present frontiers in research and in the development of business. His team, consequently, is made up of top-rank men, particularly on the scientific side, and this proved invaluable in meeting the challenge presented by "one-step" color photography.

Here is what the team faced. In conventional color photography a picture is taken on film which must then be processed. The processing is accomplished in 10 steps taking 51 minutes. In order to secure a print 12 more steps are taken requiring 42 minutes—a total of 93 minutes exclusive of drying time. What they were asked to do was devise a one-step process, actuated by the pulling of a tab, providing a dry, hardened photograph in 60 seconds.

AND THEY DID IT! What they actually did was devise an entirely new system of color photography making use of what is known as the "diffusion transfer technology", first employed in Polaroid's black and white process. Use of the same method in color photography was made possible by the discovery of a way to link developer and dye in a single molecule so that the molecule controls its own transfer from the negative to the positive. Diffusion transfer technology calls for a film that contains everything needed to make a picture, in this case a color picture—silver to record the image, a chemical mechanism to relate the exposed

silver to the new linked developer and dye molecules, and a reaction that moves the designated molecules from the negative to the positive, holding them to form a color image.

In one regard the system reverses conventional procedure. With conventional film two sets of dyes are made during processing—one in the negative and the other in the positive. The selection of dyes is limited to those that can be made during processing by what is known as the coupler method. With a dye linked to a developer in a single molecule, Polaroid is able to put dyes in the film at the time it is manufactured, thus simplifying processing and eliminating most of the variables that might change the character of the dye reaching the final print.

The print is produced by the subtractive method which calls for an extremely complex negative that will record red, green and blue light in separate emulsion layers, and which will, when processing begins, convert this record by releasing the appropriate cyan, magenta and yellow linked developer and dye molecules so they can diffuse to the positive and form a bright subtractive image. To do this the negative has eight layers with a total thickness of less than a human hair.

The team which developed "one step" color photography comprised hundreds of scientists, technicians, engineers and others under the general direction of Dr. Land. The color research laboratory was under the direction of Howard G. Rogers, who joined Polaroid after leaving Harvard University and began his career with Dr. Land working on Polarizers. He was charged with the responsibility for the process research and he conceived most of the basic system and the photo

mechanisms involved. He was the principal inventor of the negative structure and the inventor of the key concept of the color-forming mechanism.

Dr. Land himself not only started the project and made the major decisions as to direction and emphasis, but he was responsible for many inventions including the positive structure. He had the responsibility too, of bringing to bear on the color program the experience and technology of his black and white process.

Dr. Ellan R. Blout, vice president and general manager of research, headed up a group of skilled chemists who created more than 5,000 completely new compounds for achieving certain of the processes visualized by Rogers. Over 200 patent applications stemmed from their efforts.

OTHER BRILLIANT men played leading parts in an achievement likely to have a profound effect on the photographic industry—and on the fortunes of Polaroid and its many supplier firms—for a great deal of the manufacturing is farmed out as a matter of policy. The company, for example, has entered into an arrangement with Kodak for the manufacture of color negative, using Kodak's established methods and facilities. Outside firms manufacture the camera under Polaroid supervision and with polaroid engineers on the spot to check quality control. Only the positive sheet and the processing pods are made exclusively by the company.

The development means new business, new jobs, added pleasure for millions of photographers—but what probably pleases Dr. Land most is the indication it affords of the way industry can develop in the future by the establishment in manufacturing of a creativity cycle. □



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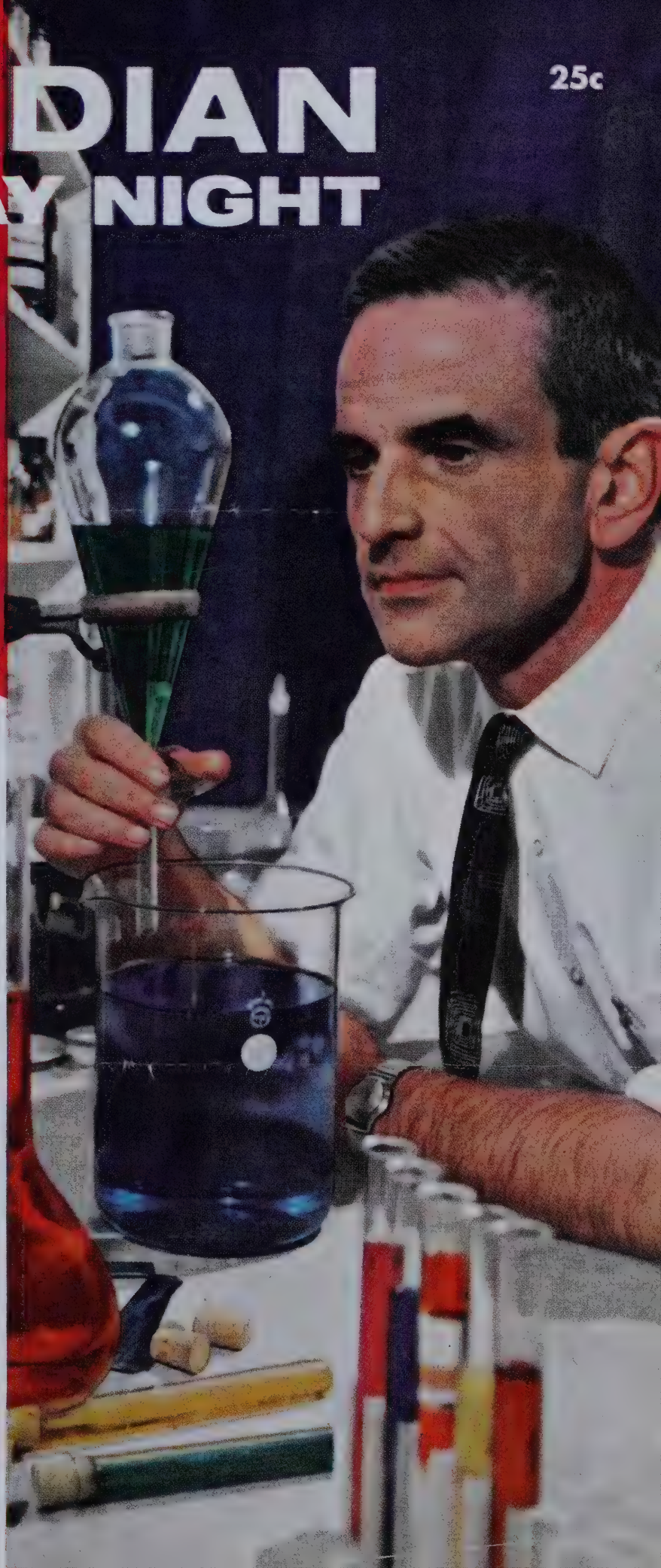
**ONE-MINUTE COLOR
TRIUMPH OF
1963 PHOTOGRAPHY**

American Leadership
As Europe Sees It
Chronicles of Zadok



The Finest Music Building

**COLOR RESEARCHER
HOWARD G. ROGERS**



THE COVER: Howard G. Rogers was director of color research under Dr. Edwin H. Land in the development of "one step" color photography. His picture on the cover was taken using the new process as were the other color photographs in this issue including the portrait by Karsh.

INFORMATION ABOUT POLAROID LAND COLOR FILM



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The new Polaroid Land Color Film makes it possible for the user to snap the shutter, pull a tab, wait about 50 seconds and lift a completely finished full-color picture from the back of the camera.

This booklet gives a description of this new film, called Polacolor Film. Included are some of the problems that had to be overcome in its invention, biographical notes about the people who were in large measure responsible for its development and a simplified description of how it works.

Dozens of new inventions, many new molecules and hundreds of new laboratory and manufacturing techniques are embodied in this new film. Of these, two concepts — one having to do with the negative and one with the positive — were of especial importance in the development of Polacolor Film.

THE NEGATIVE

The first of these was the concept of using a pre-formed dye linked to a developer in a single molecule so the molecule could control its own transfer from the negative to the positive. The idea for such a molecule and the way it could be used solved many problems and is, in effect, the heart of the negative in the new Polacolor Film.

In conventional color photography, dyes are not put in the film at time of manufacture but are created after exposure and during processing by the "coupler" method. With a dye linked to a developer in a single molecule, Polaroid is able to put dyes in the film at the time it is manufactured, thus simplifying processing and eliminating most of the variables that might change the character of the dye that reached the final print.

In addition, the developer part of the molecule is used as a mechanism for controlling how much dye stays in the negative and how much reaches the print. This concept greatly increases the number of dyes that might be considered to meet the requirements for correct color, for stability in the negative and for permanence of the finished print.

THE POSITIVE

The second major concept was a new kind of positive structure that produces an unusually stable and luminous color image. Furthermore, the print does not require coating or washing (as do Polaroid Land black-and-white prints). To achieve this, the positive had to satisfy seemingly impossible require-

ments: first, it had to permit the developer reagent to remain alkaline long enough to develop the negative and form the positive image. Then, in a matter of seconds, it had to change the surface toward a neutral or acid state so oxidation from the air wouldn't muddy the image when the picture was lifted from the camera.

Three principal layers are used in this structure to create an ionic "hold-and-release" mechanism that holds an acid layer virtually inactive until the negative has been developed and the positive formed. Near the end of the processing time, the acid layer does its job both by capturing sodium ions (alkali) which migrate to it, and by generating water and circulating it through the image layer to wash out the remaining ions. Without these ions, the molecules in the image layer around the dyes can get closer together and form a tough bond that embeds the dyes in a clear, brilliant, neutral layer. This gives excellent colors with good stability.

To better relate these key concepts to the new process that makes full color pictures in 50 seconds we must answer the questions: What were the problems? How were they solved? How does the process work? Who was involved?

THE PROBLEMS

There were several basic problems and from these, many other problems were generated. It would be impossible to mention all of them here. Some, however, can be listed to indicate the scope of the project:

1 To make a finished color picture in a camera, not the darkroom. This meant finding a one-step process that would replace the 22 steps it takes in most conventional color photography to make a negative and from that a color print.

2 To be able to see this one-step color picture at once. This called for greatly reducing the 93 minutes, plus drying time, required in conventional color to make a negative and print — reducing 93 minutes to about 50 seconds.

3 To make a film that would work in existing Polaroid Land Cameras. This called for a system that would make use of the diffusion transfer technology first employed in Polaroid's black-and-white process.

4 To create a process that would allow the camera user to get his picture without being aware of the chemical reactions going on inside. This called for a film that would contain everything needed to make a picture — silver to record the image, developer to

process that silver, a chemical mechanism to relate this exposed silver to the new linked developer and dye molecules already in the film, and a reaction that would move the designated molecules from negative to positive and hold them to form an image.

5 To have a bright, luminous print. This could best be made by the subtractive method. It called for an extremely complex negative that would record red, green and blue light in separate emulsion layers, and which would then, when processing began, convert this record by releasing the appropriate cyan, magenta and yellow linked developer and dye molecules so they could diffuse to the positive and form a bright subtractive image. To achieve all this the negative has more than eight layers whose total thickness is less than half that of a human hair.

6 To create a picture that would come out of the camera ready to enjoy without coating or washing. This called for a complex positive which had an ionic hold-release mechanism that would allow the image to form in a highly alkaline state, and then at the right instant reduce the positive to a near neutral or acid state and wash out the unwanted sodium ions (alkali) from the image layer.

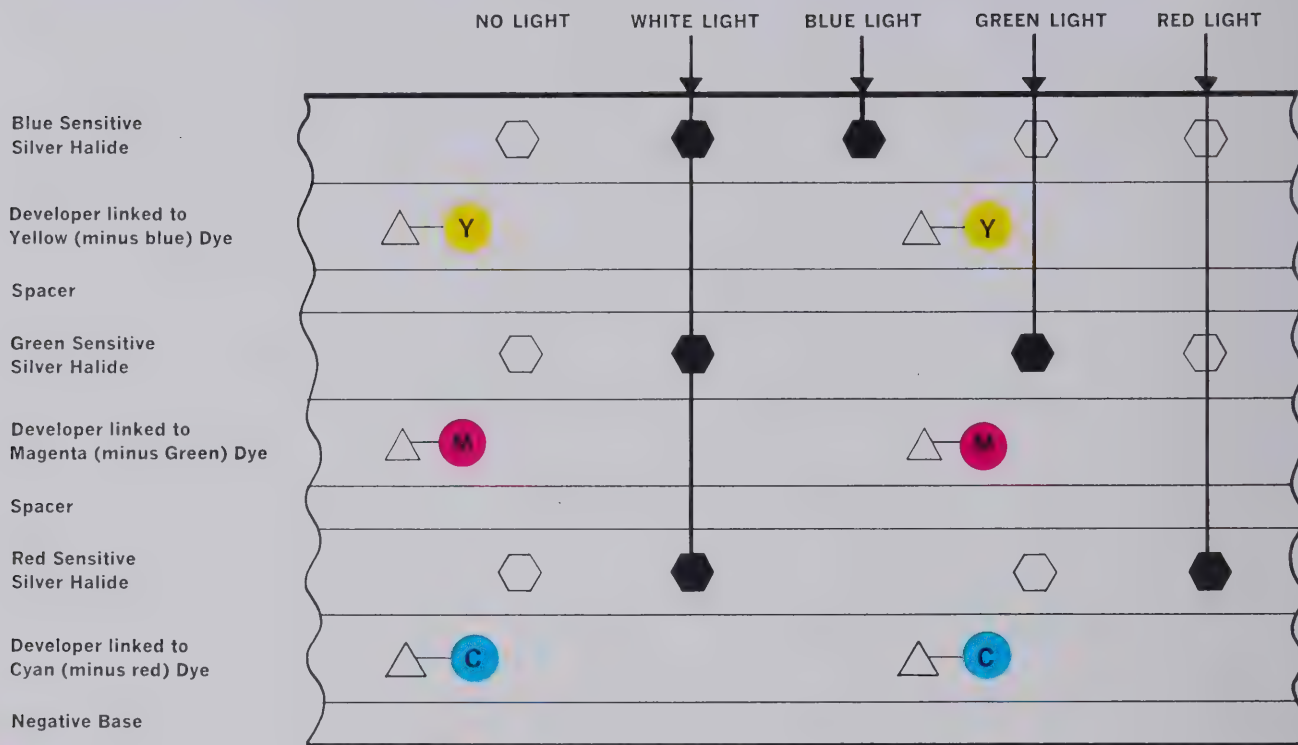
7 To have a picture whose dyes would be stable. This was done by putting dyes specially selected for stability into the negative at the factory, using the linked molecules described above. It was also helped by the special positive structure that, after it had performed its job of washing the image layer, had a molecular structure that would seal the dyes in a tough, clear layer.

8 To have a process that did not require precise time and precise temperature control. This meant finding a different approach than the coupler method of creating dyes during processing, as in conventional color film. It was done by creating the linked developer and dye molecules which perform over a broad temperature range. In addition, because of the new positive structure, little or no change takes place after the minimum development time.

9 To create a process that would lend itself to known film manufacturing technology. This was done first by keeping that technology in mind while the process was being created, and second by modifying the process near the end of the development program so it could be manufactured on existing equipment.

To better understand these problems and the solutions found for them, the Polaroid Land Color Film process is detailed on the next two pages.

How Polaroid Land Color Film Works



1. STRUCTURE OF THE NEGATIVE

The principal layers of the negative are shown in the drawing above. Remember, this is magnified 6,000 times. The total thickness of all these layers (coated on a sturdy base) is less than half the thickness of a human hair.



This symbol represents an entirely new kind of molecule which is a dye linked to a developer by an inactive atomic thread. This non-conducting leash does not allow interchange of electronic charges between the dye and developer, but it does give the developer group control over the

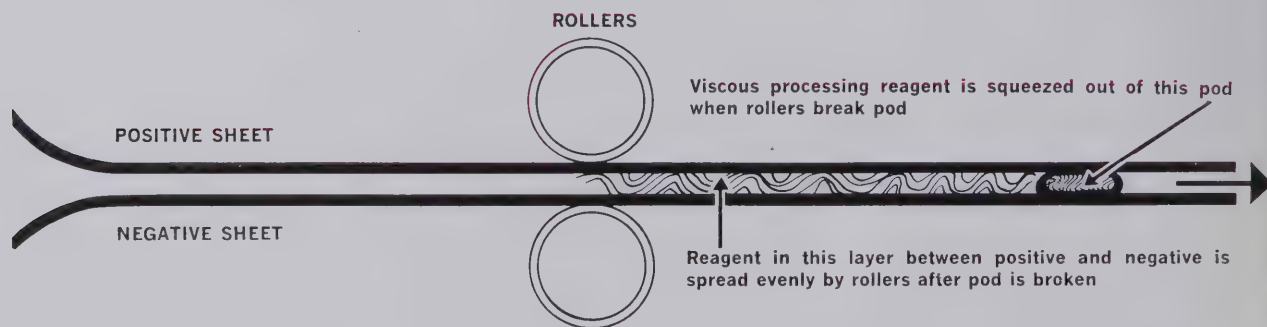
movement of the dye. The dye part of these hitched molecules must be different in each layer.



These are unexposed grains of silver halide.



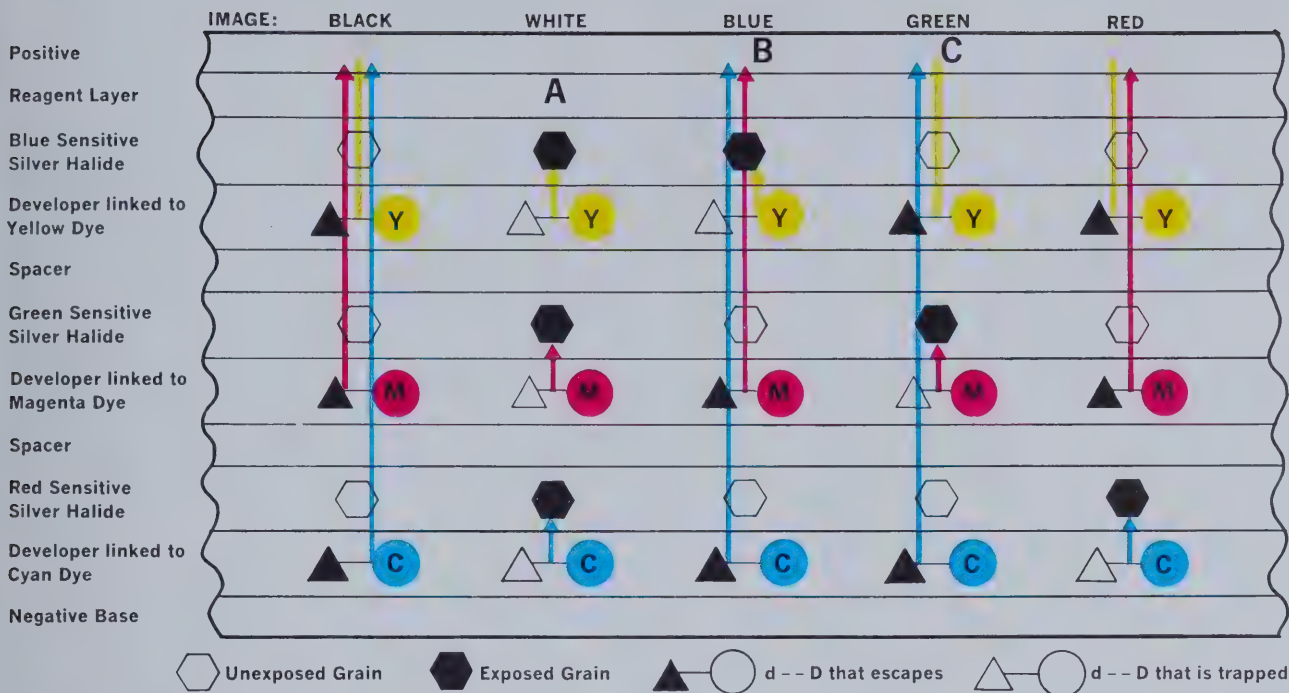
These are exposed grains of silver halide. Note, as example, how a ray of green light will pass through the blue sensitive layer without exposing the silver halide, will expose a grain in the green layer, but not in the red layer.



2. TO PROCESS PICTURE

When tab is pulled on camera, the negative, positive and a pod are pulled through a pair of rollers. This action breaks the pod and releases the viscous processing reagent in a thin layer between the negative and positive. The processing reagent is alkaline in nature

This whole system makes use of the Land diffusion transfer technology as well as the mechanical system in the Polaroid black-and-white process. Thus, it is possible to use Polaroid Land Color film in most existing Land cameras



3. WHAT HAPPENS IN NEGATIVE DURING PROCESSING

After the tab is pulled and the pod broken, the reagent works its way through all layers of the negative in seconds. As the reagent reaches a linked molecule of developer and dye, it sets the whole molecule in motion in all directions. This moving linked molecule is likely to reach its own emulsion layer first because that layer is closest.

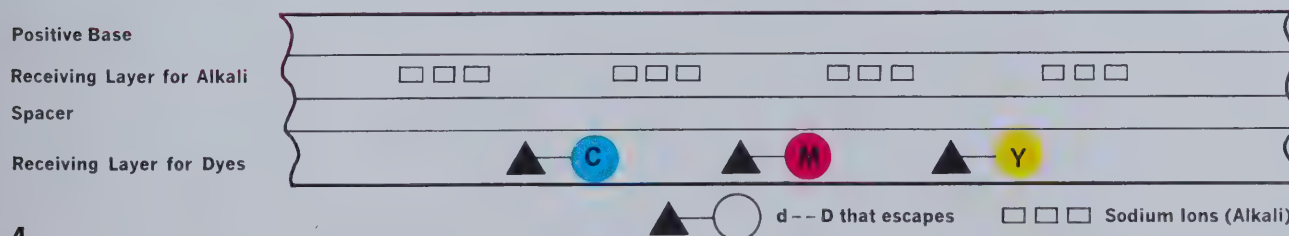
If the moving linked molecule comes close to an exposed grain, it becomes involved in development of that grain, and becomes trapped in that layer, as in A in the diagram. This is because during development of the grain, the developer portion of the linked molecule loses most of its mobility and by its atomic leash to the dye holds the dye at that point.

If the moving linked molecule hits an unexposed grain, it keeps moving. If it escapes its own emulsion layer, it can

keep moving until it hits the positive even though it might encounter exposed silver halide in other emulsions. This is because by the time it reaches these exposed grains they already have been developed by molecules originally close to the exposed grain. See B in diagram.

It is the escaping linked molecules that form an image on the positive. A ray of green light exposes a silver halide grain in that layer. This exposed grain traps the linked molecule of developer and magenta dye, but permits linked molecules from the cyan and yellow regions of the negative to reach the positive. Together these two dyes form a green image by not subtracting green as in C of the diagram. Other colors are formed in the same manner, depending on which dyes reach the positive as shown in the diagram.

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4. WHAT HAPPENS IN POSITIVE DURING PROCESSING

The positive consists of three principal layers (see above).

The receiving layer for the alkali consists of large acid molecules that are immobile, even after alkali reaches them.

The spacer layer keeps these acid molecules from coming in contact with the receiving layer for the dyes and, in addition, slows down the rate at which the alkali reaches the acid molecules.

The receiving layer for the dyes accepts and holds the linked molecules that escape the negative. This mordant layer holds the dyes much as cloth holds dye during dyeing.

This positive must permit the reagent to remain alkaline long enough to develop the negative and form the positive image, yet must reduce it to a near neutral or acid state by the time the picture is lifted from the camera.

Thus, during most of the 50-second processing time, the dyes are moving into the image layer and very little alkali is getting through the spacer layer. The receiving layer for the alkali is virtually inactive until the image is fully formed.

At about that instant, however, the acid molecules in this layer have combined with the small amount of alkali that has seeped through the spacer layer, and the resultant water that is generated opens the spacer layer and is circulated through the image layer to help remove the remaining sodium ions (alkali).

With these ions removed, the molecules around the dyes in the image can get closer together and form a tough bond that embeds the dyes in a clear, brilliant and neutral layer that permits unusually luminous colors.

THE PEOPLE

Hundreds of scientists, technicians, engineers and others participated in the research and development program for the new Polacolor Film. It would be impossible to credit all of them in detail, but here are some sketches outlining domains of responsibility and the contributions of key people in the project:

HOWARD G. ROGERS, Manager of Color Research, was charged with the responsibility for the process research. He conceived most of the basic system and the photo mechanisms involved. He is the principal inventor of the total structure of the negative and the inventor of the key concept of the color-forming mechanism which is built around a new molecule that links a developer and dye.

This single concept of using a preformed complete dye linked to a developer in a single molecule so it could control its own transfer solved many problems. For example, in conventional color photography, dyes are not put in the film at the time of manufacture, but are created after exposure and during processing by the coupler method. Rogers' concept meant the image dyes could be put in the film at the time it was manufactured, thus simplifying processing and eliminating most of the variables that might change the character of the dye that reached the final print.

In addition, by proposing that the molecule have two parts, Rogers could use the developer part as a mechanism for controlling which dyes stayed in the negative and which reached the print. There were many other advantages to Rogers' linked developer and dye molecule, including the fact that it makes possible a greatly increased choice of dyes to meet the requirements for correct color, for stability in the negative and for permanence of the finished picture.

Rogers also contributed by giving stimulus to the synthetic chemists by posing ideal molecules that would perform functions he needed in the process. He shares with these chemists many of the patents issued for new compounds.

Rogers joined Polaroid after leaving Harvard University, and began his career working with Dr. E. H. Land on polarizers. Later, he started in the black-and-white laboratory and when Land decided to make the color project a full-time goal, he assigned Rogers to head the work.

DR. EDWIN H. LAND, President and Director of Research. His responsibilities and contributions were in three principal areas. First, he started the project and made the major decisions as to direction and emphasis.

Second, he made many inventions, including the positive structure. He conceived and developed this structure which eliminates the after-coating of the picture, yet leaves the dyes embedded in a brilliant, clean layer of plastic. (This invention has special significance for the user. Had the problem not been solved, the new film would have gone to market with a requirement that the user coat the print almost immediately — and even that would have allowed some loss of color clarity.)

Third, Land had the responsibility of bringing to bear on the color program the experience and technology of his black-and-white process. To begin with, the color program drew on the black-and-white process by using the same camera mechanism, making use of silver halide in much the same way, using a pod so there would be a fresh reagent for each picture, using a viscous reagent, and using the exhaustive aspects of the Land diffusion transfer technology.

When the black-and-white process was restated in terms of color, such problems as production of continuous tonal scale in the positive, the maintenance of good photographic quality from freezing to tropical temperatures, and the balancing of rates of development for both the negative and positive had their counterparts in the color project. These problems had been solved with black-and-white, and it was Land's responsibility to work with Rogers to bring this experience to the color program.

Land founded Polaroid Corporation shortly after leaving Harvard University, building his new company around his invention of the first polarizer for light in the form of an extensive synthetic sheet. This polarizer has been used widely in scientific instruments, sunglasses, 3-D movies and for many other purposes. He announced his discovery of Land black-and-white one-step photography in 1947 and since that time has seen his company grow to the second largest photographic concern in the world.

Land is a Visiting Institute Professor at Massachusetts Institute of Technology. He has been a science consultant to both President Eisenhower and President Kennedy. He is a fellow of the National Academy of Science and a past president of the American Academy of Arts and Sciences.

THE FOLLOWING FOUR PAGES contain Polaroid Land Color pictures made by photographers in many different parts of the world. All plates were engraved directly from the original 50-second prints. Opposite page: picture by Marie Cosindas; fourth page: picture by Richard Arlington. Reprinted from Rangefinder Magazine.





Milton H. Greene



Merle Morse

Weston Kemp



POLAROID LAND COLOR PICTURES!

These are some of the first Polaroid Land color pictures to appear in print. As illustrated here, the film performs well in a wide variety of situations. *Far left above:* Milton H. Greene made this picture of seven Parisian models in the Grand Palais. *Left above:* The Baptistery at Pisa was shot in bright sunlight by Meròe Morse. *Left below:* Pretty girl in a colorful sweater was photographed by Wes Kemp on a hazy, overcast day. Note good detail, even in dark color areas.

The four pictures below show the wide range of color faithfully reproduced on the new film. *Autumn leaves* with yellow and orange tones reflect the light of the low afternoon sun. *Greek windmill* on the island of Mikonos stands out from the vivid blue of the Aegean. *Glassware* strongly backlit through the window is subtly colored in pastels. *Fisherman* mending nets on the beach at Nauplia, Greece, is strongly crosslit by bright Mediterranean sun.



Peter Fleming



Robert Dupere



Marie Cosindas



Meròe Morse



DR. ELKAN R. BLOUT, Vice President and General Manager of Research, took the responsibility of heading a group of skilled chemists who created more than 5,000 completely new compounds suited for achieving the many specific tasks visualized by Rogers. This group, working with Land and Rogers, came up with many important inventions, and over 200 patent applications stemmed from their efforts.

As example, it was a joint Blout-Rogers invention that provides for the insulation of the two parts of the molecule so that the dye part will not change its color as result of a chemical change in the developer part.

The problems Blout and his group faced in creating the precise linked developer and dye molecules needed were exceptionally difficult. Typically, the chemists might create a molecule by finding how to link a good developer group to a dye of the ideal shade and stability only to find that the solubility characteristics of this completed molecule did not match the solubility characteristics of the dye molecules in the other layers. Thus this molecule, which might have taken six weeks to synthesize and which was so desirable in so many ways, was in the last analysis unusable.

Dr. Blout, educated at Princeton and Columbia, came to Polaroid in 1943. In addition to his work at Polaroid, he is known for research on synthetic polypeptides and proteins at Children's Cancer Research Foundation. Blout has recently been appointed Professor of Biological Chemistry at Harvard Medical School, and will take up his duties there early in 1963. He will continue as a Polaroid consultant.

WILLIAM J. McCUNE, JR., Polaroid Engineering Vice President, came into the program as a primary contributor after the research had settled on the general approach, and the problem of manufacturing the complex film had to be tackled. He has been responsible for the development and engineering of facilities for the manufacture of the negative by Polaroid at some future date, and for the facilities at Polaroid that make the positive sheets and pods. He also has been responsible for coordinating on Polaroid's behalf the joint program with Eastman Kodak for the manufacture of the negative (Kodak's role is defined in detail below).

McCune, an M.I.T. graduate, came to Polaroid in 1939 and has been responsible for engineering at Polaroid, including products and manufacturing facilities.

DR. MILTON GREEN, Assistant Manager of Organic Chemical Research, worked primarily on the synthesis of the linked developer and dye molecules in all three categories — yellow, magenta and

cyan. He is jointly responsible with Rogers for an innovation which is extremely effective in helping the process achieve its high degree of color separation. He is a graduate of M.I.T. and Columbia University and has been with Polaroid for about 10 years.

DR. HOWARD C. HAAS, Manager of Polymer Research, headed up the work of creating high polymers for use in the negative and positive. Of special note is the work he did on the mordant layer of the positive which holds the dye image. Haas has been at Polaroid since 1949 when he received his Ph.D. from the Polytechnic Institute of Brooklyn.

DR. MYRON S. SIMON, Assistant Manager of Organic Chemical Research, also worked on the linked developer and dye molecules, particularly in the cyan and magenta categories. In addition to this synthesis, he did much on the relationship between molecular structure and absorption spectra of organic molecules. He joined Polaroid shortly after receiving his Ph.D. from Harvard University.

DR. GEORGE R. BIRD, Manager of Physical Chemical Research, worked on mechanism of oxidation and reduction, as well as on instruments for the determination of rates of development and the kinetics of photographic reactions. A graduate of Harvard, he taught at Columbia and Rice Institute before joining Polaroid in 1958.

DR. RICHARD S. CORLEY, Manager of Analytical Research, was responsible for the development and application of analytical methods for the determination of trace impurities in the various chemical components of the Polaroid color negative. Also a Harvard graduate, he joined Polaroid shortly after he was awarded his Ph.D. in 1950.

EASTMAN KODAK After the approach of using the linked developer and dye molecules was well along, techniques for making the new molecules had been found, and Polaroid had made full color pictures from multilayer negatives, Polaroid approached Kodak. A joint program whose objective would be to have Kodak in a position to manufacture color negative for Polaroid was proposed. Polaroid would manufacture all of the positive sheet and the processing pods.

Kodak was willing and this resulted in a coordinated effort designed to adapt Polaroid's concepts to a multilayer negative which could be manufactured commercially in Kodak's manufacturing facilities. In a parallel program, Polaroid has been developing its own techniques and facilities for the manufacture of the negative and plans to manufacture a portion of its negative requirements in its own plant.

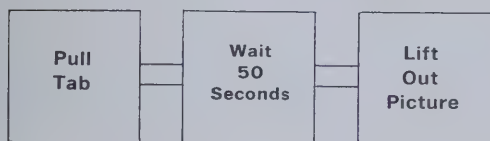
A COMPARISON BETWEEN POLACOLOR PRINTS AND CONVENTIONAL COLOR

Polaroid Land Color Film is completely different from conventional color negatives and prints. In general, these differences add up to greater simplicity in Polacolor Film.

ITEM	POLACOLOR PRINTS	CONVENTIONAL COLOR PRINTS
Processing Steps To Get Picture	One step.	22 steps. Roughly half for the negative and half for the positive.
Processing Time	50 seconds.	93 minutes, plus drying time. 51 minutes to get negative. 42 minutes to make print.
Manufacture of Dyes	At factory during manufacture of negative.	After exposure and during processing (processing may or may not be by the film manufacturer). Two sets of dyes have to be made during processing — one in the negative and then another set in the positive.
Selection of Dyes	A very large selection is available because the dyes put in the negative at the factory are unchanged during processing.	Limited to those dyes that can be made in the film after exposure and during processing by the coupler method.
Silver Halide	Used only in the negative. Both exposed and unexposed left in negative. No bleaching or fixing of silver or silver halide needed.	Used in both negative and positive. In each of these, silver is removed in two stages. First, the unexposed silver is taken out, then later the exposed silver is bleached out.
Time and Temperature	Not critical.	Very critical because manufacture of dyes is involved in processing.
Positive	Made by physical transfer, not a second exposure using light.	Exposure by light is used to print positive from negative.
Picture	Photographer sees it as he takes it, sees pictures one at a time.	Photographer must wait until processor makes picture or he does it himself in darkroom.

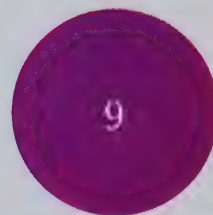
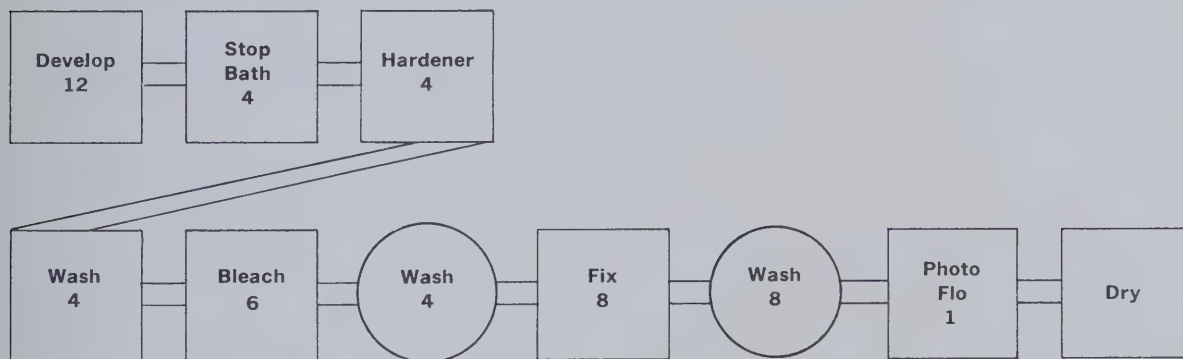


50 Seconds for a Polaroid Land Color Print



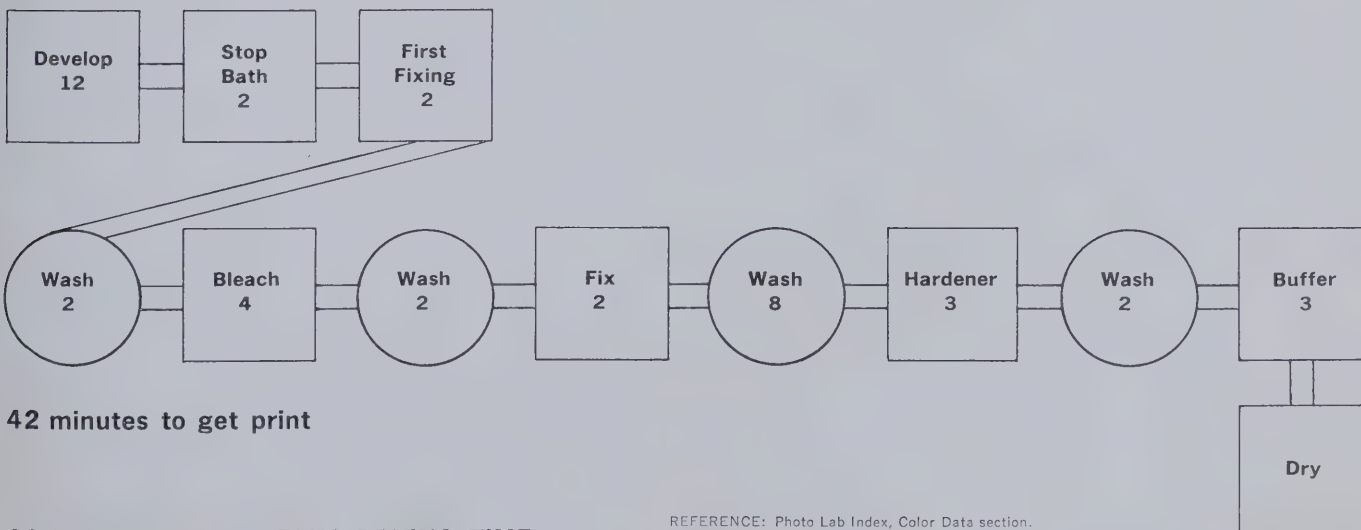
93 Minutes for a Conventional Color Print

TO PROCESS COLOR NEGATIVE



51 minutes to get negative

NOW THE PRINT (before these steps are taken, negative must be used to expose positive)



42 minutes to get print

93 MINUTES TOTAL PLUS DRYING TIME

REFERENCE: Photo Lab Index, Color Data section.
Negative process C-22. Positive process P-122.

TECHNICAL DATA

FILM SPEED 75 ASA equivalent at temperatures above 60° Fahrenheit. At lower temperatures, film speed is somewhat lower.

DEVELOPMENT TIME Approx. 50 seconds. At low temperatures, development time should be increased.

INDOOR PICTURES Blue flashbulbs or a blue shield over white flashbulbs should be used. No correction needed for electronic flash.

SIZES AVAILABLE Type 48 film for 3¼ x 4¼" pictures can be used in all existing 40-series Land Cameras. Type 38 for 2½ x 3¼" pictures can be used in J33 models. Model 80 cameras need factory modification before they can use Type 38 (see below). Both film types have 6 exposures to the roll.

COLOR TEMPERATURE Balanced for 6250°K.

RECIPROCITY The efficient working range of the film is from 1/10th to 1/1000th of a second exposure. If exposure is longer than 1/10th, both speed loss and increased yellow densities will be noted and blue filtration is recommended.

NO COATING ON FINISHED PICTURE No coating is used, unlike Polaroid Land black-and-white film. The color print comes out of the camera ready to be enjoyed but surface should not be touched for a few moments.

FILTER RECOMMENDATIONS

Daylight — none, except for special UV filters provided to go inside J66 and J33 models.

Electronic flash — none.

3200° K tungsten — 80B plus cc 20B (use ASA 12).

Photoflood — 80B plus cc 20B (use ASA 12).

COPIES AND ENLARGEMENTS Polaroid will offer:

3¼ x 4¼" copy prints (same size as original Type 48 Polacolor prints).

5 x 7" enlargement (mounted).

8 x 10" enlargement (mounted).

Note: Copies of Type 38 Polacolor prints (2½ x 3¼") will be made in the 3¼ x 4¼" size.

Copy negatives will not be offered.

ACCESSORIES Some of these are necessary, others simply provide greater convenience for the user.

Cutter bar "teeth". These should be attached to all cameras to make it easier to tear off the plastic-based negative. They will retail for 50 cents.

Electric eye Adapter. This is needed for the J66 and J33 models to convert the electric eye from 3,000 speed film to the speed of color film (it may easily be removed for black-and-white pictures). No Adapter is needed for other electric eye models.

UV (Ultra-Violet) filter. This is needed with the J66 and J33 cameras. This filter is attached inside the camera and need not be removed for black-and-white photography.

J-5 Flash Reflector. This is needed on J33 and J66 cameras for indoor pictures. It slips over the built-in flashgun (which accepts AG-1 bulbs for black-and-white photography) and makes it possible to use the larger M-3 (white) bulbs for color.

(The electric eye Adapter, the UV filter, and the flash reflector are packaged together and will retail for \$4.50.)

Timer, Model 120. Recommended for all cameras. User presets to any desired time up to 2 minutes and pushes button after he pulls the tab. When buzzing stops he lifts out picture. Screws into tripod socket.

Exposure meter, Model 625. For non-electric-eye cameras, this meter will help user get accurate exposure settings.

CAMERA CONVERSION All Polaroid Land Cameras, except Models 80, 80A and 80B, can use Polaroid Polacolor Land Film. These models must be converted at the factory.

This program will be put into effect in March, 1963 and plans and costs will be announced then.

(Note: Polaroid Corporation does not put suggested list prices on its products except in those cases where the products can be purchased directly from Polaroid as well as from dealers. Cutter bar teeth and conversion kits for the J33 and J66 cameras are available directly from Polaroid as a service to camera owners who do not have adequate nearby dealer facilities. All of these items are, of course, available through dealers.)

A CHRONOLOGY OF POLAROID LAND PHOTOGRAPHY

Feb. 21, 1947 — Dr. Edwin H. Land, President of Polaroid Corporation, announced to the Optical Society of America his invention of the picture-in-a-minute process.

Nov. 28, 1948 — The first Polaroid Land Camera, the Model 95, went on sale.

May 1, 1950 — A black-and-white orthochromatic film replaced the original sepia-tone film.

June 14, 1954 — The Model 80 Polaroid Land Camera was introduced. It was smaller, lighter and made wallet-size prints.

May 9, 1955 — Polaroid PolaPan Land Picture Rolls with ASA speed ratings of 200 and 400 went on sale.

Dec. 31, 1956 — The one-millionth Polaroid Land Camera was sold at the Village Camera Shop, South Orange, N. J. Today, approximately four million Land Cameras have been sold.

Feb., 1957 — Polaroid Land Projection Film to make finished black-and-white transparencies ready for projection in two minutes was introduced.

Oct., 1958 — The Polaroid Land 4x5 Film Holder, which extended the Land 60-second picture process to most 4x5 press or view cameras, was marketed.

Aug., 1959 — Polaroid Land Picture Rolls with a speed rating of 3,000 (ASA, daylight equivalent) and the Polaroid wink-light went on sale. They made possible indoor pictures without flashbulbs.

Sept. 1, 1960 — Polaroid announced its first fully-automatic camera, the Model 900. A unique electric eye and shutter system controlled both lens opening and shutter speed.

Sept. 29, 1960 — Polaroid announced that development time for all picture rolls had been reduced from one minute to 10 seconds.

Sept., 1961 — The Type 55 Positive/Negative Polaroid Land 4x5 Film Packet was marketed. It produced both a finished 4x5 black-and-white print and a fully-developed negative in 20 seconds, outside the darkroom.

Jan. 28, 1963 — Polaroid Land Color Film was marketed.



